

UNCLASSIFIED

AD NUMBER	
AD040375	
CLASSIFICATION CHANGES	
TO:	unclassified
FROM:	confidential
LIMITATION CHANGES	
TO:	Approved for public release; distribution is unlimited.
FROM:	Controlling DoD Organization: Naval Proving Ground, Dahlgren, VA.
AUTHORITY	
USNSWC Notice dtd 14 Aug 1975; USNSWC Notice dtd 14 Aug 1975	

THIS PAGE IS UNCLASSIFIED

UNCLASSIFIED

AD 40.375

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION ALEXANDRIA, VIRGINIA

CLASSIFICATION CHANGED

TO: Unclassified

FROM: Confidential

AUTHORITY: USNSWC notice, 14 AUG 75



UNCLASSIFIED

AD NO. 440325

ASTIA FILE COPY

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

REPORT NO. 948

WARHEADS FOR AIR TARGET GUIDED MISSILES;  
TESTING OF

40th Partial Report

AAP ROD-PRODUCING WARHEAD AND  
ROCKET MOTOR; FRAGMENTATION OF

FINAL Report

Copy No. 13

Task  
Assignment MPG-Re3f-607-1-52  
Classification CONFIDENTIAL  
SECURITY INFORMATION

AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of

-----

PART A

SYNOPSIS

1. This test was conducted to determine the fragmentation characteristics of AAP rod-producing warheads. These warheads were made from NE 8737 steel tubing, internally grooved, heat treated to Rockwell "C" 40-44, and Composition C-3 loaded.
2. The AAP warhead expelled rod-like fragments up to 8" in length evenly about the warhead circumference at an average velocity of 4160 ft./sec.

## AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of

TABLE OF CONTENTS

	<u>Page</u>
SYNOPSIS . . . . .	1
TABLE OF CONTENTS. . . . .	2
AUTHORITY. . . . .	3
REFERENCES . . . . .	3
BACKGROUND . . . . .	3
OBJECT OF TEST . . . . .	3
PERIOD OF TEST . . . . .	4
REPRESENTATIVES PRESENT. . . . .	4
DESCRIPTION OF ITEM UNDER TEST . . . . .	4
PROCEDURE. . . . .	5
RESULTS AND DISCUSSION . . . . .	5
CONCLUSIONS. . . . .	6
APPENDIX A - AAP WARHEAD DRAWINGS. . . . .	FIGURES 1-3 (Incl)
APPENDIX B - FRAGMENT DISTRIBUTION DATA. . . .	TABLE I
APPENDIX C - FRAGMENT VELOCITY DATA. . . . .	TABLES II-III (Incl)
APPENDIX D - MASS DISTRIBUTION DATA. . . . .	TABLE IV FIGURES 4-7 (Incl)
APPENDIX E - DISTRIBUTION. . . . .	1-2 (Incl)

**NOTICE: THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE  
NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING  
OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 and 794.  
THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN  
ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.**

CONFIDENTIAL

NPG REPORT NO. 948

**AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of**

-----

**PART I**

**INTRODUCTION**

**1. AUTHORITY:**

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3f-607-1-52, reference (b).

**2. REFERENCES:**

- a. NOL Conf ltr NP/NOL/X11(270) WG:SW:mbw Ser 01569  
of 6 September 1951
- b. BUORD Conf ltr NP9 Re3f-EJHL:edb Ser 25777  
of 18 September 1951
- c. NPG Conf Report No. 858 of 13 October 1951
- d. NPG Conf Report No. 854 of 1 September 1951

**3. BACKGROUND:**

a. Reference (b) authorized the Naval Ordnance Laboratory to work directly with the Naval Proving Ground in the development and testing of guided missile warheads.

b. Reference (d) reported the fragmentation characteristics of the notched ring AAP warhead. Reference (c) reported the fragment mass distribution of two types of AAP rod-producing warheads, Type 4. Four additional AAP rod-producing warheads, were delivered to the Proving Ground for fragmentation tests.

**4. OBJECT OF TEST:**

This test was conducted to determine the fragmentation characteristics of AAP rod-producing warheads. These warheads were made from NE 8737 steel tubing, internally grooved, heat treated to Rockwell "C" 40-44, and Composition C-3 loaded.

CONFIDENTIAL  
SECURITY INFORMATION

CONFIDENTIAL

NPG REPORT NO. 948

~~AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of~~

5. PERIOD OF TEST:

a. Date Project Letter	6 September 1951
b. Date Necessary Material Received	27 September 1951
c. Date Commenced Test	5 December 1951
d. Date Test Completed	7 December 1951

6. REPRESENTATIVES PRESENT:

This test was witnessed by Messrs. S. Wolf and J. R. Burton representing the Naval Ordnance Laboratory.

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

Four rounds of AAP rod-producing warheads were assembled with inert AAP rocket motors. Detailed assemblies are shown in Figures 1, 2, and 3. The warheads were made from NE 8737 steel tubing, internally grooved to produce 24 rod-like fragments and heat treated to Rockwell "C" 40-44. The warheads were assembled with mock-up VT fuzes modified for static detonation and then loaded with Composition C-3 at the Proving Ground. The weights of the components were as follows:

Rd. No.	Serial No.	Motor Wt. lbs.	Head Wt. with Fuze lbs.	Filler Wt. lbs.	Total Wt. lbs.
1	505-1	38.85	17.10	4.60	60.55
2	505-2	38.75	17.10	4.61	60.46
3	505-3	38.80	17.32	4.46	60.58
4	505-4	38.80	17.15	4.50	60.45

CONFIDENTIAL  
SECURITY INFORMATION

## AAF Rod-Producing Warhead and Rocket Motor, Fragmentation of

## 8. PROCEDURE:

a. Round No. 1, Serial No. 505-1, was detonated in a sawdust filled chamber for mass distribution data. After the detonation, the sawdust was sifted and the fragments recovered by the use of sieves and a magnetic separator.

b. Rounds Nos. 2, 3, and 4, Serials Nos. 505-2, 505-3, and 505-4, were detonated in a 30.6 foot radius velocity arena. The arena consisted of 15 foot high 1" thick steel panels in longitude zones  $350^{\circ}$ - $55^{\circ}$  and  $125^{\circ}$ - $190^{\circ}$ . A cane fiberboard pack 4' high 8' wide, and 4' thick was placed with its center 5 feet off the ground, in the  $90^{\circ}$  longitudinal plane, and 30.6 feet from the center of the arena for recovery of sample rod-like fragments. The velocity determinations were obtained by high speed photographic technique. Angular fragment distribution and fragment lengths were recorded from impacts on the panels. All rounds were placed vertically with the warhead up on a wooden stand in the center of the arena and detonated statically.

## 9. RESULTS AND DISCUSSION:

## a. Mass Distribution

Detailed mass distribution data of Round No. 1, Serial No. 505-1 are listed in Table IV and shown in Figure 4. The number and lengths of the rod-like fragments are as follows:

No.	Approx. Size	No.	Approx. Size
10	8"	6	4 1/2"
2	6"	27	2" - 4"

The motor fragmented satisfactorily, considering that it contained no propellant.

~~AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of~~**b. Fragment Space Distribution**

One of the three warheads detonated for space distribution and velocity detonated low order. The warhead is shown in Figure 6. The other two detonated high order producing rod-like fragments. The fragments were distributed evenly, approximately 15° apart about the circumference of the warhead at approximately 93° of latitude measured from the forward end of the missile. The rocket motor is the forward end of this missile with the warhead the base end. The rod-like fragments had a tendency to remain about 6" to 8" in length with some breaking into two lengths. Detailed fragment length and angular distribution data are listed in Table I. Sample warhead and motor fragments recovered are shown in Figures 5 and 7.

**c. Fragment Velocities**

The rod-like fragment velocity from the warheads 505-2 and 505-3 averaged 4160 ft./sec. The motor fragments which hit in latitude zone 75°-78° averaged 2500 ft./sec. These fragments were from the rear section of the motor nearest the warhead. The major portion of the motor fragments were found within 400 feet of the arena center and their velocity is estimated to be 200-500 ft./sec. Detailed fragment velocity data are listed in Tables II and III.

**PART D****CONCLUSIONS**

10. The AAP warhead expelled rod-like fragments up to 8" in length evenly about the warhead circumference at an average velocity of 4160 ft./sec.

CONFIDENTIAL

NPG REPORT NO. 948

AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of

The tests upon which this report is based were conducted by:

V. PHILIPCHUK, Fragmentation Battery Officer,  
Fragmentation Division,  
Terminal Ballistics Department

This report was prepared by:

V. PHILIPCHUK, Fragmentation Battery Officer,  
Fragmentation Division  
Terminal Ballistics Department

This report was reviewed by:

R. H. LYDDANE, Director of Research  
Terminal Ballistics Department

W. B. ROBERTSON, Lieutenant Commander, USN,  
Terminal Ballistics Batteries Officer,  
Terminal Ballistics Department

R. T. RUBLE, Lieutenant Commander, USN,  
Terminal Ballistics Officer,  
Terminal Ballistics Department

C. C. BRAMBLE, Director of Research, Ordnance Group

APPROVED: IRVING T. DUKE  
Rear Admiral, USN  
Commander, Naval Proving Ground



C. T. MAURO  
Captain, USN  
Ordnance Officer  
By direction

CONFIDENTIAL  
SECURITY INFORMATION

54723

CONFIDENTIAL

NPG REPORT NO. 948

U. S. NAVAL PROVING GROUND  
DAHLGREN, VIRGINIA

Fortieth Partial Report

on

Warheads for Air Target Guided Missiles;  
Testing of

Final Report

on

AAP Rod-Producing Warhead and  
Rocket Motor; Fragmentation of

Project No.: NPG-Re3f-607-1-52  
Copy No.: 11  
No. of Pages: ?

Date:

MAR 27 1952

CONFIDENTIAL  
SECURITY INFORMATION

R-32-300-8-1

1964-1487  
Bald Doves sk. 3156  
Outline drawing of a female and a  
juvenile. Figure 1  
December 1951

5515165

REAR IGNITER

IGNITER

SMOKE

SMOKE

FUEL

ROCKET MOTOR

REAR IGNITER

SMOKE

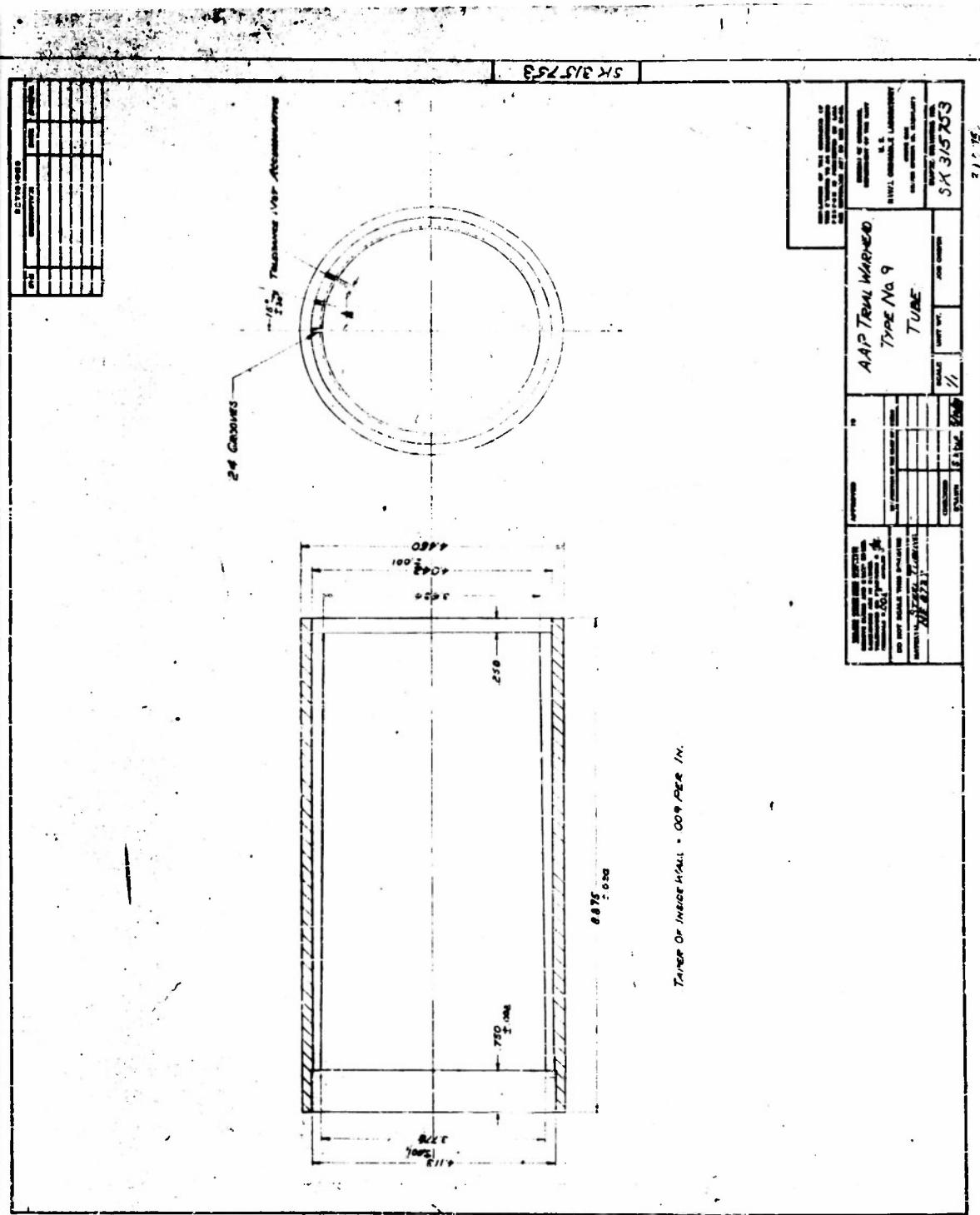
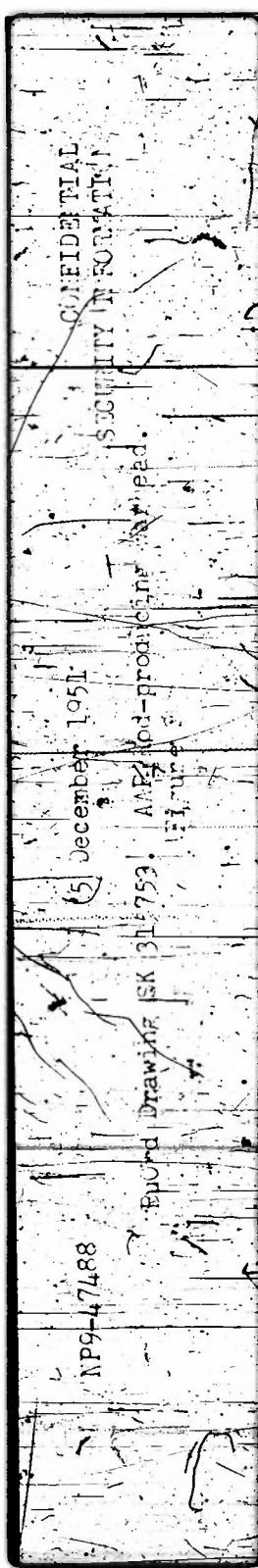
SMOKE

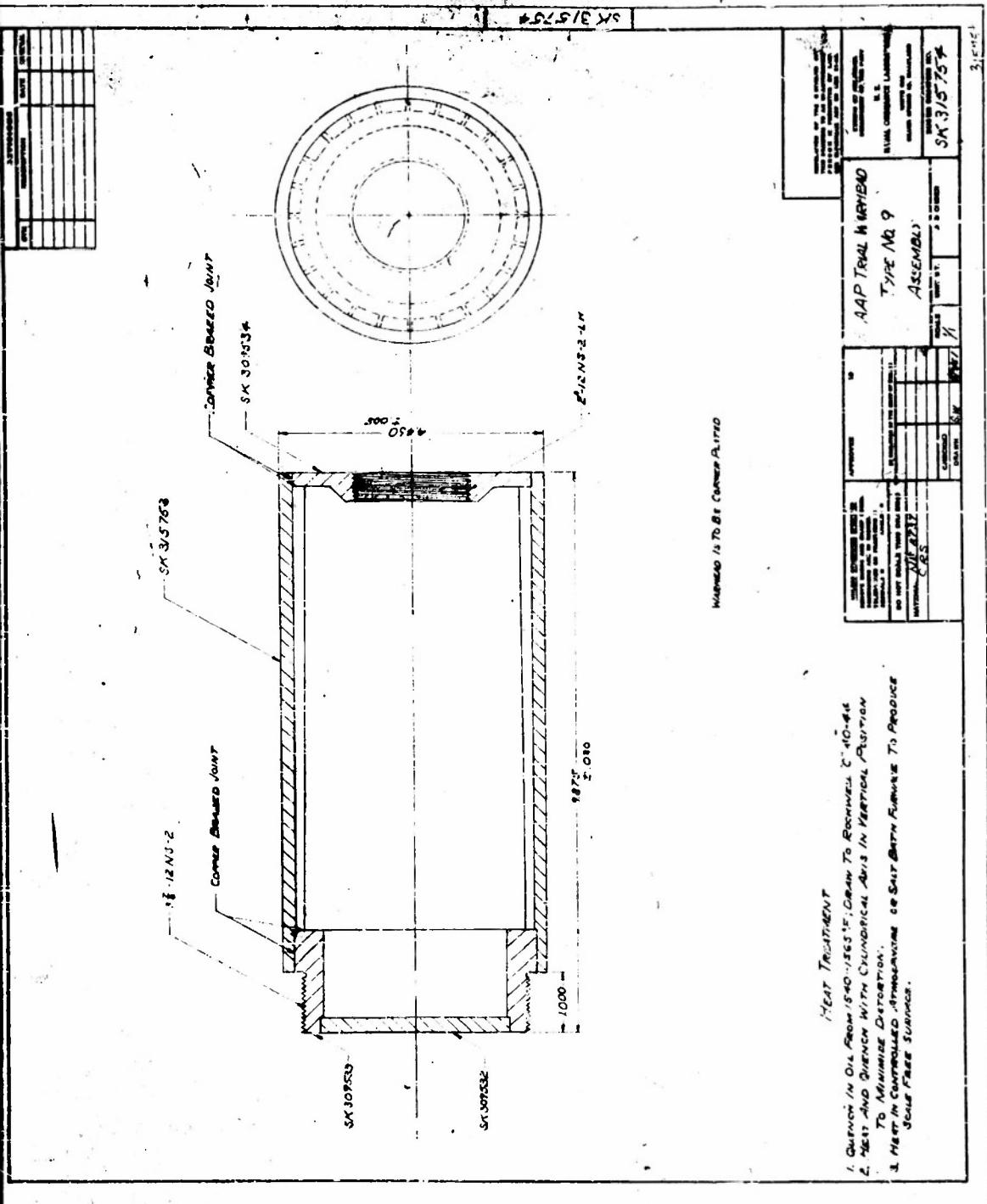
FUEL

ROCKET MOTOR

5515165

ASSEMBLY		AER-TRIAL WARHEAD	
TYPE		TYPE No. 6	
7251 ASSEMBLY			
DO NOT SCALE THIS DRAWING			
MATERIAL			
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100
101	102	103	104
105	106	107	108
109	110	111	112
113	114	115	116
117	118	119	120
121	122	123	124
125	126	127	128
129	130	131	132
133	134	135	136
137	138	139	140
141	142	143	144
145	146	147	148
149	150	151	152
153	154	155	156
157	158	159	160
161	162	163	164
165	166	167	168
169	170	171	172
173	174	175	176
177	178	179	180
181	182	183	184
185	186	187	188
189	190	191	192
193	194	195	196
197	198	199	200
201	202	203	204
205	206	207	208
209	210	211	212
213	214	215	216
217	218	219	220
221	222	223	224
225	226	227	228
229	230	231	232
233	234	235	236
237	238	239	240
241	242	243	244
245	246	247	248
249	250	251	252
253	254	255	256
257	258	259	260
261	262	263	264
265	266	267	268
269	270	271	272
273	274	275	276
277	278	279	280
281	282	283	284
285	286	287	288
289	290	291	292
293	294	295	296
297	298	299	300
301	302	303	304
305	306	307	308
309	310	311	312
313	314	315	316
317	318	319	320
321	322	323	324
325	326	327	328
329	330	331	332
333	334	335	336
337	338	339	340
341	342	343	344
345	346	347	348
349	350	351	352
353	354	355	356
357	358	359	360
361	362	363	364
365	366	367	368
369	370	371	372
373	374	375	376
377	378	379	380
381	382	383	384
385	386	387	388
389	390	391	392
393	394	395	396
397	398	399	400
401	402	403	404
405	406	407	408
409	410	411	412
413	414	415	416
417	418	419	420
421	422	423	424
425	426	427	428
429	430	431	432
433	434	435	436
437	438	439	440
441	442	443	444
445	446	447	448
449	450	451	452
453	454	455	456
457	458	459	460
461	462	463	464
465	466	467	468
469	470	471	472
473	474	475	476
477	478	479	480
481	482	483	484
485	486	487	488
489	490	491	492
493	494	495	496
497	498	499	500
501	502	503	504
505	506	507	508
509	510	511	512
513	514	515	516
517	518	519	520
521	522	523	524
525	526	527	528
529	530	531	532
533	534	535	536
537	538	539	540
541	542	543	544
545	546	547	548
549	550	551	552
553	554	555	556
557	558	559	560
561	562	563	564
565	566	567	568
569	570	571	572
573	574	575	576
577	578	579	580
581	582	583	584
585	586	587	588
589	590	591	592
593	594	595	596
597	598	599	600
601	602	603	604
605	606	607	608
609	610	611	612
613	614	615	616
617	618	619	620
621	622	623	624
625	626	627	628
629	630	631	632
633	634	635	636
637	638	639	640
641	642	643	644
645	646	647	648
649	650	651	652
653	654	655	656
657	658	659	660
661	662	663	664
665	666	667	668
669	670	671	672
673	674	675	676
677	678	679	680
681	682	683	684
685	686	687	688
689	690	691	692
693	694	695	696
697	698	699	700
701	702	703	704
705	706	707	708
709	710	711	712
713	714	715	716
717	718	719	720
721	722	723	724
725	726	727	728
729	730	731	732
733	734	735	736
737	738	739	740
741	742	743	744
745	746	747	748
749	750	751	752
753	754	755	756
757	758	759	760
761	762	763	764
765	766	767	768
769	770	771	772
773	774	775	776
777	778	779	780
781	782	783	784
785	786	787	788
789	790	791	792
793	794	795	796
797	798	799	800
801	802	803	804
805	806	807	808
809	810	811	812
813	814	815	816
817	818	819	820
821	822	823	824
825	826	827	828
829	830	831	832
833	834	835	836
837	838	839	840
841	842	843	844
845	846	847	848
849	850	851	852
853	854	855	856
857	858	859	860
861	862	863	864
865	866	867	868
869	870	871	872
873	874	875	876
877	878	879	880
881	882	883	884
885	886	887	888
889	890	891	892
893	894	895	896
897	898	899	900
901	902	903	904
905	906	907	908
909	910	911	912
913	914	915	916
917	918	919	920
921	922	923	924
925	926	927	928
929	930	931	932
933	934	935	936
937	938	939	940
941	942	943	944
945	946	947	948
949	950	951	952
953	954	955	956
957	958	959	960
961	962	963	964
965	966	967	968
969	970	971	972
973	974	975	976
977	978	979	980
981	982	983	984
985	986	987	988
989	990	991	992
993	994	995	996
997	998	999	1000





1. Glycerin in Oil from 150-155°F. CROWN TO ROCKWELL C-40-46  
2. Sheet and Glycerin with Cylindrical Axis in Vertical Position  
TO MINIMIZE DETERIORATION.  
3. Heat in Controlled Atmosphere to Soften Formers to Produce  
SOLUBLE SCUMMER.

Warrant is to be carried out

NEWS

3:50 p.m.

CONFIDENTIAL

NPG REPORT NO. 948

## AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of

TABLE I

## ANGULAR DISTRIBUTION DATA

AAP Rod-Producing Warhead and Rocket Motor  
30.5 Foot Radius Arena, 15' High Panels

Rd. No. 2 Serial No. 505-2	Longitude Angle (Degrees)	Fragment Length (Inches)	Rd. No. 3 Serial No. 505-3	Longitude Angle (Degrees)	Fragment Length (Inches)	Rd. No. 4 Serial No. 505-4	Longitude Angle (Degrees)	Fragment Length (Inches)
2	8 1/4		This round detonated			6	3 *	
18	3 1/4		Low Order. See			25	8 1/4	
19	3 3/4		Figure 6.			39	7 3/4	
34	7					56	8	
51	8					92	8	
132	3					137	5	
132	4					153	5 1/4	
148	4 *					169	4 *	
164	3 *					185	6	
180	3 1/2 *							

\* These fragment lengths were probably greater. They penetrated the 1" thick STS panels and the impact openings were recorded as the fragment lengths.

CONFIDENTIAL  
SECURITY INFORMATION

APPENDIX B

CONFIDENTIAL

NPG REPORT NO. 948

AAP Rod-Producing Warhead and Rocket Motor, Fragmentation of

TABLE IX  
FRAGMENT VELOCITY DATA

35mm Fastax Camera  
Rd. 2 NOL 505-2 AAP  
30.6 foot Radius Arena  
Total Weight 60.46 lbs.

3150 frames per sec.  
Comp. C-3  
Filler Weight 4.61 lbs.

<u>Longitude Zone</u>	<u>No.</u>	<u>Frame in Which Hit Occurred</u>	<u>No. Rod-like Fragments</u>	<u>Velocity (f/s)</u>
350°-55°	5	22	5	4380
125°-190°	4	23	4	4190
350°-55°	1	24	1	4020
Median				4380
Average				4270

Motor Hits

<u>Longitude Zone</u>			<u>No. Motor Fragments</u>	
350°-55°	1			
125°-190°	1	38	2	2540
350°-55°	2			
125°-190°	1	39	3	2470

CONFIDENTIAL  
SECURITY INFORMATION

APPENDIX C

CONFIDENTIAL

NPG REPORT NO. 948

44P Rod-Producing Warheads and Rocket Motor, Fragmentation of

TABLE III

FRAGMENT VELOCITY DATA

35mm Festax Camera  
Rd. 4 NOL 44P Warhead 505-4  
30.6 foot Radius Arena  
Total Weight 60.45 lbs.

3180 frames per sec.  
Comp. C-3  
Filler Weight 4.50 lbs.

<u>Longitude Zone</u>	<u>No.</u>	<u>Frame in Which Hit Occurred</u>	<u>No. Rod-like Fragments</u>	<u>Velocity (f/s)</u>
350°-55°	4			
125°-190°	4	24	8	4050
Average				4050

CONFIDENTIAL  
SECURITY INFORMATION

APPENDIX C

AAP Red-Producing Warhead and Rocket Motor, Fragmentation of

TABLE IV

MASS DISTRIBUTION DATA

## FRAGMENTATION OF AAP WARHEAD SERIALIZED NO. 8056-1 ASSEMBLED WITH MOCK-UP VT FUZE MODIFIED FOR STATIC FIRING

WEIGHT AND WEIGHT OF RECOVERED FRAGMENTS		C-3 0-0-3515 0-615-1.25 125-2.5 2-5-5										5-20 20-30 40-50 60-70 80-90										90-100 100-110 110-120 120-130 130-140										140-150 150-160 160-170 170-180 180-190										190-200 200-210 210-220 220-230 230-240										240-250 250-260 260-270 270-280 280-290										290-300 300-310 310-320 320-330 330-340										340-350 350-360 360-370 370-380 380-390										390-400 400-410 410-420 420-430 430-440										440-450 450-460 460-470 470-480 480-490										490-500 500-510 510-520 520-530 530-540										540-550 550-560 560-570 570-580 580-590										590-600 600-610 610-620 620-630 630-640										640-650 650-660 660-670 670-680 680-690										690-700 700-710 710-720 720-730 730-740										740-750 750-760 760-770 770-780 780-790										790-800 800-810 810-820 820-830 830-840										840-850 850-860 860-870 870-880 880-890										890-900 900-910 910-920 920-930 930-940										940-950 950-960 960-970 970-980 980-990										990-1000 1000-1010 1010-1020 1020-1030 1030-1040										1040-1050 1050-1060 1060-1070 1070-1080 1080-1090										1090-1100 1100-1110 1110-1120 1120-1130 1130-1140										1140-1150 1150-1160 1160-1170 1170-1180 1180-1190										1190-1200 1200-1210 1210-1220 1220-1230 1230-1240										1240-1250 1250-1260 1260-1270 1270-1280 1280-1290										1290-1300 1300-1310 1310-1320 1320-1330 1330-1340										1340-1350 1350-1360 1360-1370 1370-1380 1380-1390										1390-1400 1400-1410 1410-1420 1420-1430 1430-1440										1440-1450 1450-1460 1460-1470 1470-1480 1480-1490										1490-1500 1500-1510 1510-1520 1520-1530 1530-1540										1540-1550 1550-1560 1560-1570 1570-1580 1580-1590										1590-1600 1600-1610 1610-1620 1620-1630 1630-1640										1640-1650 1650-1660 1660-1670 1670-1680 1680-1690										1690-1700 1700-1710 1710-1720 1720-1730 1730-1740										1740-1750 1750-1760 1760-1770 1770-1780 1780-1790										1790-1800 1800-1810 1810-1820 1820-1830 1830-1840										1840-1850 1850-1860 1860-1870 1870-1880 1880-1890										1890-1900 1900-1910 1910-1920 1920-1930 1930-1940										1940-1950 1950-1960 1960-1970 1970-1980 1980-1990										1990-2000 2000-2010 2010-2020 2020-2030 2030-2040										2040-2050 2050-2060 2060-2070 2070-2080 2080-2090										2090-2100 2100-2110 2110-2120 2120-2130 2130-2140										2140-2150 2150-2160 2160-2170 2170-2180 2180-2190										2190-2200 2200-2210 2210-2220 2220-2230 2230-2240										2240-2250 2250-2260 2260-2270 2270-2280 2280-2290										2290-2300 2300-2310 2310-2320 2320-2330 2330-2340										2340-2350 2350-2360 2360-2370 2370-2380 2380-2390										2390-2400 2400-2410 2410-2420 2420-2430 2430-2440										2440-2450 2450-2460 2460-2470 2470-2480 2480-2490										2490-2500 2500-2510 2510-2520 2520-2530 2530-2540										2540-2550 2550-2560 2560-2570 2570-2580 2580-2590										2590-2600 2600-2610 2610-2620 2620-2630 2630-2640										2640-2650 2650-2660 2660-2670 2670-2680 2680-2690										2690-2700 2700-2710 2710-2720 2720-2730 2730-2740										2740-2750 2750-2760 2760-2770 2770-2780 2780-2790										2790-2800 2800-2810 2810-2820 2820-2830 2830-2840										2840-2850 2850-2860 2860-2870 2870-2880 2880-2890										2890-2900 2900-2910 2910-2920 2920-2930 2930-2940										2940-2950 2950-2960 2960-2970 2970-2980 2980-2990										2990-3000 3000-3010 3010-3020 3020-3030 3030-3040										3040-3050 3050-3060 3060-3070 3070-3080 3080-3090										3090-3100 3100-3110 3110-3120 3120-3130 3130-3140										3140-3150 3150-3160 3160-3170 3170-3180 3180-3190										3190-3200 3200-3210 3210-3220 3220-3230 3230-3240										3240-3250 3250-3260 3260-3270 3270-3280 3280-3290										3290-3300 3300-3310 3310-3320 3320-3330 3330-3340										3340-3350 3350-3360 3360-3370 3370-3380 3380-3390										3390-3400 3400-3410 3410-3420 3420-3430 3430-3440										3440-3450 3450-3460 3460-3470 3470-3480 3480-3490										3490-3500 3500-3510 3510-3520 3520-3530 3530-3540										3540-3550 3550-3560 3560-3570 3570-3580 3580-3590										3590-3600 3600-3610 3610-3620 3620-3630 3630-3640										3640-3650 3650-3660 3660-3670 3670-3680 3680-3690										3690-3700 3700-3710 3710-3720 3720-3730 3730-3740										3740-3750 3750-3760 3760-3770 3770-3780 3780-3790										3790-3800 3800-3810 3810-3820 3820-3830 3830-3840										3840-3850 3850-3860 3860-3870 3870-3880 3880-3890										3890-3900 3900-3910 3910-3920 3920-3930 3930-3940										3940-3950 3950-3960 3960-3970 3970-3980 3980-3990										3990-4000 4000-4010 4010-4020 4020-4030 4030-4040										4040-4050 4050-4060 4060-4070 4070-4080 4080-4090										4090-4100 4100-4110 4110-4120 4120-4130 4130-4140										4140-4150 4150-4160 4160-4170 4170-4180 4180-4190										4190-4200 4200-4210 4210-4220 4220-4230 4230-4240										4240-4250 4250-4260 4260-4270 4270-4280 4280-4290										4290-4300 4300-4310 4310-4320 4320-4330 4330-4340										4340-4350 4350-4360 4360-4370 4370-4380 4380-4390										4390-4400 4400-4410 4410-4420 4420-4430 4430-4440										4440-4450 4450-4460 4460-4470 4470-4480 4480-4490										4490-4500 4500-4510 4510-4520 4520-4530 4530-4540										4540-4550 4550-4560 4560-4570 4570-4580 4580-4590										4590-4600 4600-4610 4610-4620 4620-4630 4630-4640										4640-4650 4650-4660 4660-4670 4670-4680 4680-4690										4690-4700 4700-4710 4710-4720 4720-4730 4730-4740										4740-4750 4750-4760 4760-4770 4770-4780 4780-4790										4790-4800 4800-4810 4810-4820 4820-4830 4830-4840										4840-4850 4850-4860 4860-4870 4870-4880 4880-4890										4890-4900 4900-4910 4910-4920 4920-4930 4930-4940										4940-4950 4950-4960 4960-4970 4970-4980 4980-4990										4990-5000 5000-5010 5010-5020 5020-5030 5030-5040										5040-5050 5050-5060 5060-5070 5070-5080 5080-5090										5090-5100 5100-5110 5110-5120 5120-5130 5130-5140										5140-5150 5150-5160 5160-5170 5170-5180 5180-5190										5190-5200 5200-5210 5210-5220 5220-5230 5230-5240										5240-5250 5250-5260 5260-5270 5270-5280 5280-5290										5290-5300 5300-5310 5310-5320 5320-5330 5330-5340										5340-5350 5350-5360 5360-5370 5370-5380 5380-5390										5390-5400 5400-5410 5410-5420 5420-5430 5430-5440										5440-5450 5450-5460 5460-5470 5470-5480 5480-5490										5490-5500 5500-5510 5510-5520 5520-5530 5530-5540										5540-5550 5550-5560 5560-5570 5570-5580 5580-5590										5590-5600 5600-5610 5610-5620 5620-5630 5630-5640										5640-5650 5650-5660 5660-5670 5670-5680 5680-5690										5690-5700 5700-5710 5710-5720 5720-5730 5730-5740										5740-5750 5750-5760 5760-5770 5770-5780 5780-5790										5790-5800 5800-5810 5810-5820 5820-5830 5830-5840										5840-5850 5850-5860 5860-5870 5870-5880 5880-5890										5890-5900 5900-5910 5910-5920 5920-5930 5930-5940										5940-5950 5950-5960 5960-5970 5970-5980 5980-5990										5990-6000 6000-6010 6010-6020 6020-6030 6030-6040										6040-6050 6050-6060 6060-6070 6070-6080 6080-6090										6090-6100 6100-6110 6110-6120 6120-6130 6130-6140										6140-6150 6150-6160 6160-6170 6170-6180 6180-6190										6190-6200 6200-6210 6210-6220 6220-6230 6230-6240										6240-6250 6250-6260 6260-6270 6270-6280 6280-6290										6290-6300 6300-6310 6310-6320 6320-6330 6330-6340										6340-6350 6350-6360 6360-6370 6370-6380 6380-6390										6390-6400 6400-6410 6410-6420 6420-6430 6430-6440										6440-6450 6450-6460 6460-6470 6470-6480 6480-6490										6490-6500 6500-6510 6510-6520 6520-6530 6530-6540										6540-6550 6550-6560 6560-6570 6570-6580 6580-6590										6590-6600 6600-6610 6610-6620 6620-6630 6630-6640										6640-6650 6650-6660 6660-6670 6670-6680 6680-6690										6690-6700 6700-6710 6710-6720 6720-6730 6730-6740										6740-6750 6750-6760 6760-6770 6770-6780 6780-6790										6790-6800 6800-6810 6810-6820 6820-6830 6830-6840										6840-6850 6850-6860 6860-6870 6870-6880 6880-6890										6890-6900 6900-6910 6910-6920 6920-6930 6930-6940										6940-6950 6950-6960 6960-6970 6970-6980 6980-6990										6990-7000 7000-7010 7010-7020 7020-7030 7030-7040										7040-7050 7050-7060 7060-7070 7070-7080 7080-7090										7090-7100 7100-7110 7110-7120 7120-7130 7130-7140										7140-7150 7150-7160 7160-7170 7170-7180 7180-7190										7190-7200 7200-7210 7210-7220 7220-7230 7230-7240										7240-7250 7250-7260 7260-7270 7270-7280 7280-7290										7290-7300 7300-7310 7310-7320 7320-7330 7330-7340										7340-7350 7350-7360 7360-7370 7370-7380 7380-7390										7390-7400 7400-7410 7410-7420 7420-7430 7430-7440										7440-7450 7450-7460 7460-7470 7470-7480 7480-7490										7490-7500 7500-7510 7510-7520 7520-7530 7530-7540										7540-7550 7550-7560 7560-7570 7570-7580 7580-7590										7590-7600 7600-7610 7610-7620 7620-7630 7630-7640										7640-7650 7650-7660 7660-7670 7670-7680 7680-7690										7690-7700 7700-7710 7710-7720 7720-7730 7730-7740										7740-7750 7750-7760 7760-7770 7770-7780 7780-7790										7790-7800 7800-7810 7810-7820 7820-7830 7830-7840										7840-7850 7850-7860 7860-7870 7870-7880 7880-7890										7890-7900 7900-7910 7910-7920 7920-7930 7930-7940										7940-7950 7950-7960 7960-7970 7970-7980 7980-7990										7990-8000 8000-8010 8010-8020 8020-8030 8030-8040										8040-8050 8050-8060 8060-8070 8070-8080 8080-8090										8090-8100 8100-8110 8110-8120 8120-8130 8130-8140										8140-8150 8150-8160 8160-8170 8170-8180 8180-8190										8190-8200 8200-8210 8210-8220 8220-8230 8230-8240										8240-8250 8250-8260 8260-8270 8270-8280 8280-8290										8290-8300 8300-8310 8310-8320 8320-8330 8330-8340										8340-8350 8350-8360 8360-8370 8370-8380 8380-8390										8390-8400 8400-8410 8410-8420 8420-8430 8430-8440										8440-8450 8450-8460 8460-8470 8470-8480 8480-8490										8490-8500 8500-8510 8510-8520 8520-8530 8530-8540										8540-8550 8550-8560 8560-8570 8570-8580 8580-8590										8590-8600 8600-8610 8610-8620 8620-8630 8630-8640										8640-8650 8650-8660 8660-8670 8670-8680 8680-8690										8690-8700 8700-8710 8710-8720 8720-8730 8730-8740										8740-8750 8750-8760 8760-8770 8770-8780 8780-8790										8790-8800 8800-8810 8810-8820 8820-8830 8830-8840										8840-8850 8850-8860 8860-8870 8870-8880 8880-8890										8890-8900 8900-8910 8910-8920 8920-8930 8930-8940										8940-8950 8950-8960 8960-8970 8970-8980 8980-8990										8990-9000 9000-9010 9010-9020 9020-9030 9030-9040										9040-9050 9050-9060 9060-9070 9070-9080 9080-9090										9090-9100 9100-9110 9110-9120 9120-9130 9130-9140										9140-9150 9150-9160 9160-9170 9170-9180 9180-9190										9190-9200 9200-9210 9210-9220 9220-9230 9230-9240										9240-9250 9250-9260 9260-9270 9270-9280 9280-9290										9290-9300 9300-9310 9310-9320 9320-9330 9330-9340										9340-9350 9350-9360 9360-9370 9370-9380 9380-9390										9390-9400 9400-9410 9410-9420 9420-9430 9430-9440										9440-9450 9450-9460 9460-9470 9470-9480 9480-9490										9490-9500 9500-9510 9510-9520 9520-9530 9530-9540										9540-9550 9550-9560 9560-9570 9570-9580 9580-									

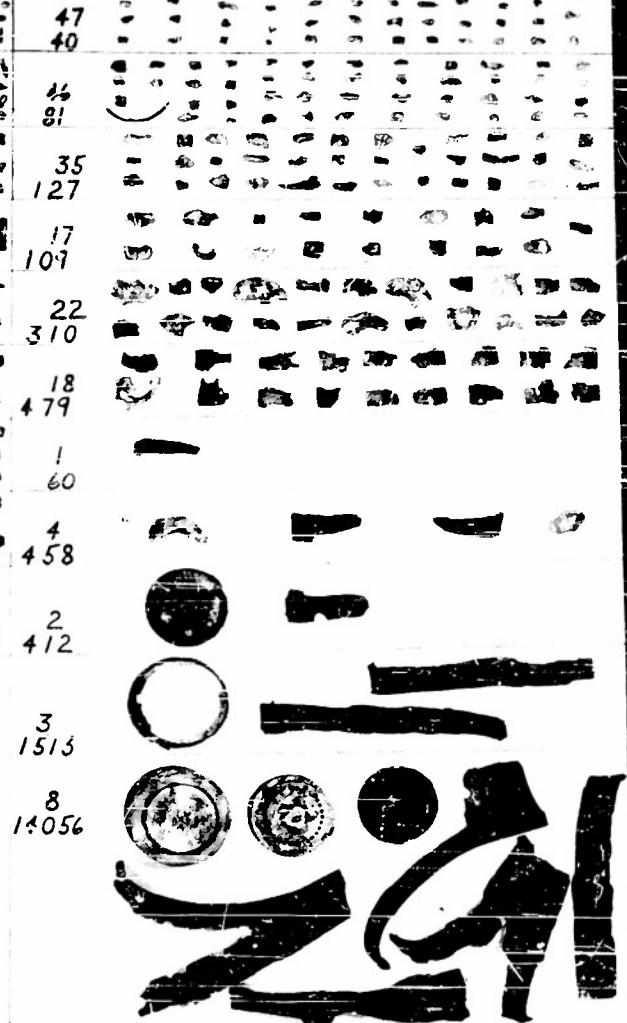
FIG. NO. 1619

HEAD

N.P.9 46967

MOTOR

0 - 4	Gms.	
593	Pcs.	
5 - 1 1/2	Gms.	
1236	Pcs.	
173	Gms.	
1 1/2 - 2 1/2	Gms.	
179	Pcs.	
178	Gms.	
2 1/2 - 5	Gms.	
73	Pcs.	
266	Gms.	
5 - 10	Gms.	
52	Pcs.	
364	Gms.	
10 - 20	Gms.	
28	Pcs.	
383	Gms.	
20 - 40	Gms.	
20	Pcs.	
576	Gms.	
40 - 80	Gms.	
23	Pcs.	
1149	Gms.	
80 - 160	Gms.	
11	Pcs.	
1303	Gms.	
160 - 320	Gms.	
7	Pcs.	
1144	Gms.	
320 - 640	Gms.	
	Pcs.	
	Gms.	
640 +	Gms.	
	Pcs.	
	Gms.	



FUZE - FRAGS  
82 Pcs.  
1029 Gms.

SCALE 1"

N.P.9 46967

7 December 1961

CONFIDENTIAL  
SECURITY INFORMATION

Mass Distribution of AAE Rod-producing Warhead and Rocket Motor Serial  
No. 505-1.

Figure 4

FRAG NO. 1617

AAP MOTOR FRAGMENTS

NOL 505-2

3 Gms.

8 Gms.

9 Gms.

9 Gms.

11 Gms.

13 Gms.

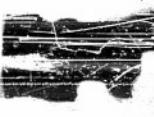
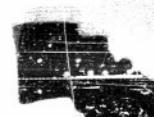
51 Gms.

99 Gms

102 Gms.

107 Gms.

135 Gms.



SCALE 1"

44-1-144

SECURITY INFORMATION

Sample Rocket Motor Fragments from AAP Serial No. 505-2 recovered in  
the field.

Figure 5



AAP FRAGMENTS.

NP4 46356

NOL 505-4

HEAD

168 Gms.

MOTOR

27 Gms.

106 Gms.

243 Gms.

357 Gms.

562 Gms.

738 Gms.

11804 Gms.

SCALE 1"

TP0 16856

5 December 1951

CONFIDENTIAL

SECURITY INFORMATION

Sample Warhead and jacket Motor Fragments from AAP Serial No. 505-4 recovered in cane fiberboard and in the field.

Figure 7

## AAP Rod-Producing Warheads and Rocket Motor, Fragmentation of

DISTRIBUTION

Bureau of Ordnance:

Ad3  
Re2  
Re3  
Re3f1  
1  
2  
5Chief of Ordnance  
Department of the Army  
Attn: ORDTX-AR

2

Navy Research Section  
Library of Congress  
Washington 25, D. C.  
(Via BUCRD Re3)

2

Commanding General  
Aberdeen Proving Ground  
Aberdeen, Maryland  
Attn: Technical Information Section  
Development and Proof Services

2

Commander, Operational Development Force  
U. S. Atlantic Fleet, U. S. Naval Base  
Norfolk 11, Virginia

1

Naval Ordnance Laboratory

1

Naval Ordnance Laboratory  
Attn: Explosives Division  
Attn: Mr. H. W. Semon

1

Picatinny Arsenal, Dover, N. J.  
Attn: Technical Division

1

Reports Office  
APL/JHU, Silver Spring, Maryland

1

APL/JHU, Silver Spring, Md.  
Attn: Mr. H. S. Morton  
(Via INSORD, Silver Spring, Md.)

1

AAP Rod-Producing Warheads and Rocket Motor, Fragmentation of

DISTRIBUTION (Continued)

Bureau of Ordnance Technical Liaison Office  
Bell Telephone Laboratories  
Whippany, New Jersey

1

USNOTS, Inyokern, China Lake, Calif.

1

Inst. for Cooperative Research  
JHU/1315 St. Paul St.

Via: (District Chief, Phila. Ord District  
1500 Chestnut St., Phila. 2, Pa.  
Attn: Mr. Edward R. C. Niles)

1

Director, Research and Development Division  
New Mexico Institute of Mining and Technology  
Socorro, New Mexico

Via: Development Contract Officer  
New Mexico Institute of Mining and Technology  
Socorro, New Mexico

1

Boeing Airplane Company  
Seattle Division  
Seattle, Washington

2

Local: OT  
OTZ  
OT-1  
File

1

1

1

1

**UNCLASSIFIED**

**UNCLASSIFIED**